balance; this rod hangs free, and is hit by a hammer, moved by clockwork, at intervals of ten minutes.

O'Reilly's is a balance barometer, but not at all similar to the foregoing, as the cistern is fixed to the tube, and the instrument is inclined from the vertical, and suspended by knife edges. The variations in the length of the mercurial column cause it to incline more or less, the amplitude of movement showing itself on a graduated arc by means of an index.

Cantoni employs a balance, but he has the tube fixed, and suspends the cistern, which is a small one, from one arm of the beam, to which is attached (underneath it) a pointer. Cecci adopts the same principle, but traces the record on smoked glazed paper (wound round a horizontal cylinder) by means of a long pointer fixed over the beam. The floating barometer of McGwire (Irish Acad. *Trans.* iv. 141, 1791) is a balance barometer, as its weight is counterpoised, or nearly so, by the wooden ring attached to the bottom of the tube. A very similar instrument was patented by McNeill (Patent, No. 1733, 1861).

Cistern Arrangements.—Prins maintained that by the following arrangement he obtained a constant level in the cistern. The reservoir has a glass cover a little below its rim; this cover has a hole in the centre rather larger than the tube which passes through it, through this space the mercury rises and spreads more or less over the cover. In Gloukhoff's barometer the mercury in the cistern is forced by means of a screw to pass through a hole, and to cover a glass ring. Then the movable scale is lowered so as to make the steel end touch the surface of the mercury. Amagat proposed to adjust the level in the cistern by means of an iron or glass cylinder which was forced down by a screw. Poleni (1740) adjusted the level by the immersion of a screw. Austin (Roy. Irish Acad. *Trans.* iv., 99, 1791) kept the level of the mercury in the cistern constant by overflow from an aperture in the side into a bag underneath. Hamilton (Roy. Irish Acad. *Trans.* v., 95, 1792) fitted his barometer with an ivory cistern, the upper part of which was closed by a cork ring; this being porous allowed air to pass through, but retained the mercury. The cistern which is most used is that of Fortin; it is a short, wide, glass cylinder which is fixed by three pillars, the ends of which have screws passing through an upper and a lower brass plate, by means of which the necessary pressure can be applied to make it mercury-tight. At the bottom of the cistern is a leather bag, which is raised or lowered by an adjusting screw, so that the surface of the mercury may be brought into contact with an ivory point which forms the zero of the scale; this point is seen through the glass cistern. The cistern of Green's barometer, which is used by the United States Signal Service, is essentially the same as Fortin's. Negretti and Zambra (Patent, No. 238, 1861) patented the following. The cistern is screwed at the upper part to fittings near the bottom of the tube, so that by turning it round it will be raised until a cushion or pad placed at the bottom of the cistern is brought up against the open end of the tube. Alvergnat (*Rev. Hebd. d. Chim.* March 1870) proposed a very elementary form on the same principle. Paul de Lamanon ("Observations sur la Physique," xix., 3, 1782) in order to determine to what extent the expansion of the mercury influenced the height of the column, marked a zero point on the shorter limb of a siphon barometer. Gay-Lussac (*Ann. de Chim.* i., 113, 1816), who pointed out that, by having the tube of the same diameter at both surfaces of the mercury, correction for capillarity was unnecessary, also made his barometer portable by sealing the top of the shorter limb with the exception of a very fine hole. At the same time he made the lower portion of the longer tube and the bend of tube of sufficiently small diameter to keep the mercurial column from breaking. Bunten introduced a great improvement by inserting an air-trap in the barometer tube. This he effected by drawing off the lower extremity of the upper half of the tube to form a capillary; he then sealed the lower half of the tube to the shoulder of the contraction, so that any air accidentally entering the tube would collect round this shoulder and not break the continuity of the column or destroy the vacuum. Lefranc (*Pogg. Ann.* lxxiv, 462, 1849) objected to Bunten's tube as being very liable to fracture, and proposed to guard against the admission of air by drawing off the lower limb of the siphon to a capillary tube, and then fitting to this tube by means of a perforated cork a short tube which is, midway, contracted to a very small diameter. De Luc used the siphon barometer, but made the instrument portable by inserting in the shorter limb an ivory stop-cock which had a cork plug, but with a small ivory tube in the cork. Blondeau constructed a very similar instrument, but made it of iron, and took his readings by means of a float. Stevenson's is an iron siphon barometer provided with stop-cocks at both limbs, so that it can be easily charged or emptied. Bogen (Patent, No. 2532, 1877) patented the following barometer:—The long leg of the siphon is closed at one end, and is supplied with a glass stopper, with a fine hole through it, at the other. The tube is filled, the stopper is inserted, and, the hole through the stopper being closed by the finger, the tube is inverted and a portion of the mercury allowed to flow away to produce a vacuum. The short leg is of the same diameter, and is formed with a semicircular bend at one end, which is ground to receive the open end of the long limb. The short limb is then partly filled with mercury, the two parts are fitted together, and the tube is brought to a vertical position. The level is read off by the same method as that employed by Derham, but with screw in place of rack and pinion. It stands on a centre, so that by turning the instrument round it can be seen whether the column is vertical. Greiner (Dove's *Repert. d. Phys.* i., 31, 1837), 1835, drew the bend off to a capillary, which entered the bottom of the open limb of the siphon. A short distance from the bottom this tube is contracted, and when the barometer is to be moved a plug is pressed into this contraction. W. Symons (Patent, No. 813, 1863) proposed to have no contraction, but to make the plug close the capillary opening. Dorwin (Patent, No. 1386, 1862) suggested a siphon barometer with cistern and stopcock in place of open limb; the cistern to be covered with chamois leather, and the stopcock to have india-rubber connectors above and below. Bohn constructs his instrument with enlarged tubes at the two surfaces of the mercury; the lower one surmounted by a narrow tube for the purpose of filling, and the upper one by a stopcock to facilitate the operation.

JAS. T. BROWN

ON MONOSTROMA, A GENUS OF ALGÆ

NOW that so much time and thought are devoted to the study of the green algæ, Dr. Wittrock's elaborate Monograph of the genus Monostroma [1] will be found a most desirable addition to our knowledge of these plants. The following abstract of this very interesting work may therefore not be unacceptable to the reader.

In the Introduction Dr. Wittrock, who writes in Swedish, relates all that is known concerning the history of the formation of the genus, the discovery of the species, the changes which have taken place in the classification, and the works which treat of the subject.

The genus Monostroma was formerly included in Ulva. Kützing was the first who divided the species of Ulva into those which were formed of one layer of cells and those which consisted of two layers. The former he called Ulva, the latter Phycoseris. Thuret afterwards formed the species with one layer into the new genus Monostroma. According to his arrangement Monostroma is included in the second order Zoosporeæ, sub-order, 1, Chlorosporeæ.

Of the affinities of Monostroma it will be sufficient to say that, through the bladder-like form at an early period of growth of two species, *M. bullosum* and *M. Grevillei*, (the *Ulva lactuca* of Harvey), it approaches to Enteromorpha, from which it differs in acquiring, at a later period, an expanded leaf-like form, whereas Enteromorpha always retains its tubular character. But a more effective distinction is found in the structure of the frond, which shows a nearer affinity with Tetraspora (which belongs to the Palmellaceæ). The chief distinction between Monostroma and Tetraspora lies in the zoospores, which, in *M. bullosum*, are (as in the other Ulvaceæ) oval, with the smaller end somewhat drawn out into a kind of beak (rostrum), to which cilia are attached. In Tetraspora the zoospores are nearly round, without a rostrum, but with two long cilia fastened to the zoospores, which can only be distinguished by their lighter colour.

To Prasiola Monostroma is also near. From this it is distinguished by the position of the cells, which are here never arranged in quadratic or rectangular groups, and by the holdfast or root-organs.

The frond (thallus) in Monostroma, at least in mature specimens, is a flat, membranous expansion. In two of the species it is, when young, in the form of a bladder or closed bag, which soon splits

[1] Försok till en Monographi öfver Algslägtet Monostroma, af V. B. Wittrock. Upsala, 1866.

and spreads open. In some species the frond is more or less lobed and laciniated, the margins either undulated, entire, or jagged. The species also vary in the thinness or thickness of the frond. The colour is always greenish, passing sometimes from yellowish to white, and, in one species, is quite dark.

In the young state the frond always adheres to some object, such as stones, rocks, or other algæ, but in most species it becomes detached, and lies at the bottom of the sea.

As to the internal structure of the frond, it is, on the whole, very thin, and the principal part is formed of a single layer of cells, which lie in the same plane. It is provided with a more or less abundant intercellular substance, and is held together by a cuticle, which incloses the whole frond.

The lower part of the frond, when attached to some object, has a more compound structure. The cells, as regards their form, situation, and other particulars, are more developed. In mature specimens of all the species yet examined, except *M. bullosum*, they are often of a lengthened club-shaped form, and lie with their thickened ends side by side, while the smaller ends wind about each other, and sometimes almost interlace. The cells are, moreover, of larger size than those in the upper part of the frond, so that the lower part of the frond is much thicker than the upper. In some cases other cells, resembling those in the upper part of the frond, are mixed with the club-shaped cells. From a transverse section of this part of the frond it would appear to be formed of two or even three layers of cells, of which only one is single, namely, that which is formed of the thickened ends of the cells; the other consists of their thin ends and of smaller cells. Somewhat different arrangements of the cells of the lower part of the frond are noticed in the description of species.

It is, therefore, the upper part of the frond only which is monostromatic. The cells in this part vary in form; some are rounded and have rather prominent angles, others are angular, with the angles sometimes rounded off, but occasionally quite sharp. Their longest axis is sometimes at right angles with the surface, at others it is horizontal. As to the position of the cells with regard to each other, in some species this is irregular, without any special order; in others the cells are grouped with more regularity two and two, three and three, or four and four together. They are separated more or less by the intercellular substance. The species which give the best examples of this kind of grouping are *M. bullosum*, *M. laceratum*, and *M. quaternarium*.

The substantial part of the frond consists of an inclosing membrane and its contents. The membrane, which is a true cellulose membrane, is, in mature examples, of most of the species very thin, and quite hyaline, therefore very difficult to detect. The most important part of the cell contents are the chlorophyll-bodies which are coloured by chlorophyll. In some species they fill the cells entirely and naturally take their form; in others they fill only half or even a less portion of the cells, and lie like a band across the cells parallel to the surface of the frond.

Within the chlorophyll-bodies are found abundantly round grains of starch; except for these the contents of the upper part of the fronds are tolerably homogeneous.

No nucleus (*cellulkärna*) has as yet been observed with certainty. In the monostromatic parts of *M. Grevillei* there are often seen, about the centre of the cells, almost circular light spots which remind one of a nucleus, but of which the nature has not yet been ascertained. The cells of which the lower part of the frond is composed have already been noticed; it is only necessary to add that the cells here are never so close together as in the upper part of the frond, and that the interstices are filled with small portions of the intercellular substance.

The chlorophyll-bodies in the club-shaped cells never fill the entire space, but keep strictly to the form of the cells, and long streaks of this substance pass through their shafts quite to the point. Starch grains, or at least starch in an amorphous state, is here always found, and even when it could not be observed the chlorophyll bodies always assumed a dark-blue colour when iodine was applied.

The intercellular substance plays a considerable part in the structure of the frond. In some species it forms as much as half of the whole mass. In others, and these are the most numerous, it is less in quantity but of equal importance. It lies, in all the species, with one exception, not only between the cells themselves, but also in the large space between the cells and the cuticle.

The cuticle is very thin and pellucid, and covers the whole frond except the fibrous-rooting processes (*fästtågorna*) before mentioned.

In the young state the frond is attached to some object by a hold-fast ((*fästnöl*), which is formed partly of the intercellular substance, and partly of the lower parts of the club-shaped cells at the base of the plant. The ends of these cells and the intercellular tubstance are both inclosed by the cuticle. The hold-fast is irregular in form, rather flat, and always very small. Instead of this hold-fast, two of the species are provided with rooting processes (*fästtågorna, fibrillæ alligantes*), which consist of a few simple fibres, and which are found on older plants after they have become detached. These fibres are nothing but the ends of the shafts of the club-shaped cells, which, instead of remaining within the cuticle, push through it, and take the place of the hold-fast.

By these root organs is Monostroma, well separated from Prasiola, to which it is otherwise near. The root-organs in Prasiola are, as Jessen has shown in his meritorious monograph on the genus Prasiola, very different. Whereas in Monostroma the cells partake in forming the hold-fast, in Prasiola the fibres proceed from the intercellular substance, and are inclosed in the cuticle. In Monostroma the fibres are simple, but in Prasiola they are branched, sometimes even anostomosing, and, in parts, almost reticulated.

Monostroma is entirely without special reproductive organs, but when the plant has reached maturity the cells become fruitful. At a certain period the contents of the cells are transformed into zoospores, which, after swimming about for a short time, fix themselves to some object and develop into young plants. As there are at least four zoospores in every cell, a middle-sized frond must produce many thousands of them; hence it will be seen what a powerful means they are of increasing and multiplying the plant.

The exact nature of these small organs has not been thoroughly studied. For what is known on the subject we are indebted to Areschoug's able essay "On the Formation of the Zoospores in *M. Grevillei*," and also to Thuret's remarkable work, "Recherches sur les Zoospores des Algues."

Nothing is known as to the way in which the zoospores are formed in the cells. All that is really known is that the parts of the cells which undergo transformation are the chlorophyll bodies, but how the green contents of the cells change into zoospores, and whether by successive or by simultaneous division, are problems still enveloped in total obscurity.

When the zoospores are formed numbers of them lie in the cells moving about their smaller ends. After a time they lie still; then, under the influence of light, they may be seen turning about in their cells as if struggling to get out of their narrow prison. A round hole then forms in the cell-membrane and in the cuticle, whence the zoospores speedily escape. After a short time the motion ceases, and they lie in the cells, where they probably soon die.

The time of the day when the zoospores issue from the cells is generally between four and six in the morning. Sometimes, especially in autumn, the swarming takes place later in the day, even in the afternoon. In some of the Ulvæ, according to Thuret, the swarming does not occur at any special time of the day.

The zoospores, in the species which are best known, are of an oval form, the lower end being drawn out into a rostrum, to which are attached two cilia, of about the same length as the zoospores. Sometimes there are found in all the species two kinds of zoospores, the one with four, the other with two cilia. The former are nearer to germinating spores, the latter to resting spores. In many other Ulvaceæ two kinds of zoospores have also been observed.

The colour of the zoospores is green, but the smaller end is lighter in colour or almost hyaline. The cilia are always colourless.

The free zoospores have a voluntary motion, and two distinct movements. First, they turn quickly each on its own axis, and secondly, they move now forwards, now in circles, then in straight lines, now one way, then another.

As to how this motion is produced, and which part of the zoospores is most efficacious in causing it, various opinions prevail. Up to the present time the most general belief is that the cilia are the locomotive organs. Another opinion was, however, expressed by Prof. Areschoug in the *Transactions* of the Academy of Upsala for the year 1866, namely, that the

zoospores in motion have a power of contracting and expanding very quickly, and of very considerably changing their form; this changing of form, he considers, constitutes in itself the mechanism of motion. In this essay he has clearly proved that in the algæ then under examination, the cilia cannot be the true organs of motion.

The zoospores originate always in the cells that lie on or near the margin of the frond; they afterwards appear in abundance in the upper parts of the frond, whence they spread gradually downwards, till they fill up all the cells of the monostromatic part.

When the motion finally ceases, the zoospores fasten themselves to some object near at hand, and then begin to develop into young plants. The zoospores which, till this time, were formed of the bare protoplasm only, are now covered with a cellular membrane. The cilia disappear, and a process of division commences, which, however, in the species of this genus, has not been studied. In several other well-known Ulvæ, this division takes place first in one dimension, but afterwards in two; thus an expanded membrane is formed. This increase in size takes place, according to the observations of authors, principally, but not exclusively, in the periphery of the frond, or on the apex, if there be one. The youngest parts of the plants are thus always at the top, and the oldest at the base. In this way the frond acquires a tolerable leaf-like aspect.

As before-mentioned, the frond does not in all the species remain attached during its whole life to some object. It is often found, fresh and in full vigour, lying loosely at the bottom of the water in which it grew. Thus, according to the experience of authors, these free examples are entirely monostromatic. Hence there is reason for the opinion that, in this case, the frond divides itself into two parts, and that the division-line between them falls just on the border between the upper monostromatic part of the frond and the lower, and not monostromatic. The upper part of the frond survives for a considerable time, and generally increases in size, until the formation of zoospores begins, when it gradually decays. The fate of the other part of the frond is involved in obscurity. Dr. Wittrock thinks it not improbable that the cells may detach themselves from each other, and become a kind of fixed gonidia, which finally develop into young plants. Such a mode of increasing would agree with that which, according to Kützing, occurs in several species of the genus Ulva of authors (*Phycoseris*, Ktz.), where the cells in the stipes of the plants, after the frond becomes free, put forth budding-cells. It also occurs in Prasiola.

Kützing, in his works, speaks of another kind of reproductive bodies, the so-called *Spermatia*, which he says occur in the Ulvaceæ. He describes them as brown, and as detached from the surface of the frond, also as round bodies with a thick hyaline membrane, the contents of which are brown and granular. In *Ulva latissima*, Ktz., to judge from the figure, they appear to be about three times as long as the outer cells. Dr. Wittrock had been unable, after diligent search, to find them. To Thuret their use was unknown, and Jessen supposed that they proceeded from some accidental deformity of the common cellular tissue.

No genus in the whole vegetable kingdom has so wide a range as Monostroma. It has representatives in all parts of the world, but the greater part of the species prevail in the colder parts of the European temperate zone. Of the eighteen species which are known with tolerable certainty to belong to the genus twelve are found in this zone. In the southern part of the Polar regions the genus has not less than seven representatives; in the equatorial zone one species is found; south of the range of the "wild goat," only two. In Europe there are fifteen species; in Asia, two (or, including *M. fuscum*, three); in Africa, one; in North America, one; in South America, one; and in Australia, three species.[1]

Many of the species grow in salt water, some prefer brackish, others inhabit fresh water. They grow generally in shallow water, most frequently only one or two feet below the surface; but two species often grow many fathoms under water. Some species are found at nearly all times of the year, others in the spring and summer only. All are annuals.

To facilitate examination and to preserve as much as possible the natural order, Dr. Wittrock has subjoined a tabular view of the species which he has examined. The characters are here adduced partly from the form and position of the cells as shown in a transverse section of the frond, partly from the development of the chlorophyll bodies and the thickness of the frond. The arrangement of the species in this scheme is not altogether the same as that afterwards observed in the treatise.

The species are fully, even minutely described, and the monograph is illustrated by four plates, in which magnified figures are given of the surface and transverse sections of the fronds. These are extremely useful, since the species can be determined by microscopic observation only. MARY P. MERRIFIELD

[1] At present three species only of Monostroma are known to grow on the British shores, namely, *M. bullosum*, *M. Grevillei*, and *M. latissimum*. The first inhabits fresh water, the others salt water. On the north coast of France five species are found.—M. P. M.

SCIENTIFIC SERIALS

IN the most recent numbers of the *Journal of Botany* (May–July), the most interesting article is perhaps the description of a new British Umbellifer, *Selinum Carvifolia*, by Mr. F. A. Lees, illustrated by a plate. The plant is widely distributed on the Continent, and has been now discovered in Lincolnshire by the Rev. William Fowler. It has apparently been confounded with *Peucedanum palustre*, to which however it is not very nearly allied, and should be looked for elsewhere.

THE recent numbers of the *Scottish Naturalist* (October 1881–July 1882) contain the usual supply of articles on various branches of natural history, especially interesting to dwellers in or visitors to the northern parts of our island.

The American Journal of Science, June.—Respiration of plants, by W. P. Wilson.—On the question of electrification by evaporation, by S. H. Freeman.—Observations on snow and ice under pressure at temperatures below 32° F., by E. Hungerford.—On the minerals, mainly zeolites, occurring in the basalt of Table Mountain, near Golden, Colorado, by W. Cross and W. F. Hillebrand.—On a new locality for Hayesine, by N. H. Darton.—Notes on the electromagnetic theory of light, II., by J. W. Gibbs.—New phyllopod crustaceans from the Devonian of New York, by J. M. Clarke.—An organ-pipe sonometer, by W. Le Conte Stevens.

THE *Journal of the Franklin Institute*, July.—Description of the Edison steam dynamo, by T. A. Edison and C. T. Porter.—On the efficiency of the steam boiler, and on the conditions of maximum economy, by R. H. Thurston.—Note on the economy of the windmill as a prime mover, by A. R. Wolff.—Harmonic intonation of Chime bells (continued), by J. W. Nystrom.—An organ-pipe sonometer, by W. Le Conte Stevens.—Analysis of Helvite from Virginia, by R. Haines.—The absorption of metallic oxides by plants, by F. C. Phillips.—Applications of the principle of the phonodynamograph, by W. P. Cooper.—Remarks made at the closing exercises of the drawing school, May 18, 1882, by C. Sellers, jun.—Conservation of solar energy, by P. E. Chase.

THE *Bulletin of the Torrey Botanical Club* for April contains an interesting article by Mr. T. F. Allen on the "Development of the Cortex in *Chara*," illustrated by 8 plates. The author divides the species belonging to the genus into eight groups, characterised by the mode of development of the cortical cells and cortical tubes. Three new species are described.

Annalen der Physik und Chemie, No. 6.—On the electricity of flame, by J. Elster and H. Geitel.—On double refraction in glass and sulphide of carbon produced by electric induction, by H. Brongersma.—On measurement of small electric resistances, by C. Dieterici.—Note on weakly magnetic and dia-magnetic substances, by P. Silow.—Some experiments on diffusion of gases through hydrophane of Czernowitza, by G. Hüfner.—General formulæ for determination of the constants of elasticity of crystals by observation of the flexure and drilling of prisms, by W. Voigt.—On the molecular attraction of liquids for each other, by P. Volkmann.—Reply to the memoir of Herr V. v. Lang: "Determination of the quotients of refraction of a concentrated solution of cyanin," by C. Pulfrich.—Experiments on colour-mixtures, by R. Schelske.—A proof of Talbot's proposition, and remarks on some of its consequences, by F. Boas.—On the replacement of a centred system of refracting spherical surfaces by a single one of this kind, by F. Kessler.—On singing condensers, by W. Holtz.—On coloured sparks and their production by internal and external resistances, by the same.—Remarks on the production of Lichtenburg figures, by K. L. Bauer.

No. 7.—On transpiration of vapours (III. Memoir), by V. Steudel.—On the same, (IV. Memoir), by L. Meyer.—General formulæ, &c. (continued), by W. Voigt.—Volume and angular